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# The Liver as an Organ of Elimination of Corpuscular Elements.

BY

GUSTAV FÜTTERER, M.D.



REPRINTED FROM  
MEDICINE.

GEO. S. DAVIS, Publisher,  
August, 1895.







[REPRINTED FROM MEDICINE, AUGUST, 1895.]

## THE LIVER AS AN ORGAN OF ELIMINATION OF CORPUSCULAR ELEMENTS.

BY GUSTAV FÜTTERER, M.D.,

Professor of Physical Diagnosis, Chicago Policlinic.

In the year 1887 (*Munchener Med. Wochenschrift*, No. 19, 1888) I succeeded in cultivating typhoid bacilli from the contents of gall-bladders of people who had died of typhoid fever; finding no other germs, I thought it very improbable that the typhoid bacilli had come there from the intestinal canal by way of the ductus choledochus, but rather with the arterial blood current through the liver. This, if true, would demonstrate a new and very important function of the liver—that of eliminating bacterial or other corpuscular elements from the blood current.

I then commenced experimenting with animals, injecting cultures of well marked saprophytic germs subcutaneously, into veins, and into the left ventricle of the heart, and always succeeded in again cultivating these germs from the contents of the gall-bladder. After injections into the heart they could be found quickly, while it necessarily took longer to find them when they were injected hypodermically or into veins, as they had to pass the greater circulation first. Later on, experiments were made with pathogenic micro-organisms with the same result, thus demonstrating that bacteria may come to the liver by way of arterial circulation and be eliminated by this organ together with the bile into the gall-bladder; also that they are not destroyed by a bactericidal action of the bile, but may be cultivated successfully from this fluid. From the gall-bladder they naturally pass into the intestinal canal, if no obstruction of the common duct is present, and may be eliminated from the body together with the fæces. I say they *may be*, for some of them—for instance, tubercle or typhoid bacilli—may again invade the tissues of the walls of the intestinal canal and produce the characteristic changes of tuberculosis or typhoid fever (relapse). So, if we call the liver an organ of elimination of corpuscular elements from the blood by way of the gall-ducts into the intestinal canal, this would be an incomplete elimination; but these elements may, from the intestine, be carried into the outer world—complete elimination. The liver, of course, has no influence on the second mode of elimination, but its action makes the complete elimination possible and in most cases probable.

Incomplete elimination is a source of great danger, the more so



as bacteria which have passed the liver grow and multiply readily in the bile. I have tied off gall-bladders in typhoid cadavers, kept them in a glass box for several days, and then examined the contents by culture methods; these examinations showed that typhoid bacilli were present in pure cultures and in such great numbers that their having multiplied was beyond question. Considering that in bacterial invasions the quantity of the invading material is a very important factor, we must say that a few germs having reached the gall-bladder by way of the liver, having multiplied in the bile and thus reached the intestinal canal, can, under favorable conditions, again invade and cause tuberculosis, typhoid, etc. The relapses in typhoid fever are certainly caused in this way, and they are the best proof of the great danger of incomplete elimination; the late relapses are partly accounted for by the histological changes in the liver which take place during this disease. The typhoid bacillus has a peculiarity that brings it nearer to the tubercle bacillus than any other germ; I refer to its formative action on cells, which finds its expression in the formation of so-called lymphatic nodules in the liver during typhoid, which may prevent the elimination of some typhoid bacilli until degeneration takes place, thus freeing the bacilli. As the atrophy of these nodules may come sooner or later, their bearing on the question is plain. While this is probably the most common cause of retention of typhoid bacilli, there may be a number of other factors—for instance, histological changes in the liver preventing filtration of bile would favor retention, and any obstruction in the biliary passages down to the common duct will do the same; thus a gastro-enteritis, causing an obstruction or partial obstruction of the common duct at the end of typhoid fever, on removal of this obstruction becomes the cause of a relapse. In general sepsis the eliminating function of the liver may also play an important part, and it may even be the cause of septic diarrhoea.

As mentioned above, I have made all these experiments and examinations, and reached these conclusions in the year 1887, and published my opinion on the subject in No. 19 of the *Munchener Medicinische Wochenschrift*, 1888, at a time when no literature whatever existed on the subject. Since then I have made use of every occasion to verify the results of my experiments, and have had no occasion to change or modify my opinion.

In the year 1890 Gilbert and Girode published a case of cholecystitis typhosus (*La Semaine Méd.*); they found other germs besides the typhoid bacillus, and Neunyn and Letienne did the same in 1891. Letienne examined the contents of gall-bladders of typhoid cases, finding one sterile and the other to contain a bacillus which, he said, might be the typhoid bacillus or the *Bacillus coli commune* (*Arch. de*



*Méd. Expér. et d'Anatom. Path.*, iii, No. 6, 1891). Dupré (Les Infections Biliaires, Paris, 1891) reports two cases of typhoid fever with typhoid bacilli in the gall-bladder. His second case is very remarkable: a woman was operated on for cholelithiasis eight months after she had had typhoid fever, and the bile which flowed out of the gall-bladder during operation contained typhoid bacilli.

Corrado (*Centralblatt für Bacteriologie*, xi, 1891) was able to show that in different infectious diseases the respective germs passed into the gall-bladder and into the intestinal canal.

Blackstein and Gabbi (*Johns Hopkins Hospital Bulletin*) reported that they had injected cultures of typhoid bacilli and of the bacterium *coli commune* in the ear vein of a rabbit, and then succeeded in cultivating them again from the contents of the gall-bladder.

Chiari of Prague (1893) reported to the International Medical Congress at Rome a number of cases in which he made the necessary examinations, leading to the following conclusions:

1. The typhoid bacillus was, in most cases, the only germ that could be cultivated from the gall-bladder.
2. The number of typhoid bacilli was often very great.
3. Their presence in the gall-bladder is not the exception but the rule.
4. Inflammation of the walls of the gall-bladder was found repeatedly.
5. Typhoid bacilli may get into the gall-bladder from the intestinal canal, by the blood current or through the walls of the gall-bladder.
6. The growth of typhoid bacilli in the gall-bladder seems to be established, and he believes that the gall-ducts are a favorable place for their development.

Dufourt (*Infections Biliaire et Lithiase*, 1893) reports that nineteen of his cases of cholelithiasis had their first colic shortly after typhoid fever.

Lately I made the following experiment:

Dr. W. P. Verity kindly having made a gall-bladder fistula in a dog, the ducts were ligated and a culture of staphylococcus injected subcutaneously at 4.35 P.M. At 4.40 P.M. inoculations from the gall-bladder were made on beef agar, to ascertain what germ might be present, and especially to learn if the staphylococcus aureus was not there already. The inoculations, made every five minutes for the first forty-five minutes, and later every ten minutes, until 5.15 P.M., showed white colonies in every instance. Then the staphylococcus aureus appeared mixed with the white colonies, and kept on increasing in number until 6.30 P.M., when the experiment was closed. The ligation

of the ductus choledochus enabled me to find the germs much quicker than I had ever done before. I may also mention that in inoculations on sterilized bouillon or beef gelatin the glasses are kept for several days in an incubator at a temperature of  $37.5^{\circ}$  C., then inoculations from these flasks are made upon firm beef agar; in this way we are able to get a positive result even if there are only one or two germs in the drop of bile taken for examination.

I then injected hypodermically into the same dog a solution of iodide of potassium, to see how much quicker this chemical would appear in the gall-bladder than bacteria. Thinking that it would take at least five minutes, I made my first test after the lapse of that time and found such a positive reaction that I believe it may have been there two minutes earlier.

Taking everything into consideration, what I have observed and others have found, I believe that the following conclusions are justifiable:

1. The liver eliminates germs or corpuscular elements from the blood current. (Fütterer.)

2. The bile does not destroy germs, but allows them to multiply. (Fütterer.)

3. Relapses of typhoid fever may be caused by typhoid bacilli entering the intestinal canal by way of the ductus choledochus. (Fütterer.)

4. Tubercular enteritis can be caused in the same way. (Fütterer.)

5. Diarrhoea in general sepsis may also be caused in this way. (Fütterer.)

6. Typhoid bacilli may form the nucleus of gall-stones. (Dufourt, Chiari.)

7. Typhoid bacilli, on their way through the liver, can cause inflammation of the gall-ducts. (Dupré.)

8. There is a condition deserving the name cholecystitis typhosa. (Gilbert and Girode.)

9. Typhoid bacilli may be found in the gall-bladder eight months after a typhoid fever, if an obstruction prevents their being eliminated into the intestinal canal. (Dupré.)

10. Iodide of potassium injected hypodermically can be found in the gall-bladder after the lapse of five minutes, and probably even sooner. (Fütterer.)



## THE MEDICAL AGE.

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This is the title of a new medical monthly magazine that has made its appearance upon our exchange table, and which we most heartily welcome. It is the result of the enterprise of Mr. Geo. S. Davis, the well known medical publisher, ably seconded editorially by Doctor Harold N. Moyer, of Chicago, and a staff of expert collaborators and contributors, representing the foremost and best medical talent of the Northwest. *Medicine*, moreover, is representative of no college, clique, publishing house, or manufacturing concern, but is merely a high class cosmopolitan medical publication. Such names as Moyer, W. L. Baum, D. A. K. Steele, Hobart A. Hare, G. F. Lydston, W. S. Christopher, S. S. Bishop, N. S. Davis, Jr., J. B. Herrick, G. H. Weaver, H. T. Patrick, M. D. Ewell, Henry Gradle and Norman Bridge associated therewith give abundant assurance of character for the future. The April number presents original articles on "Herpes Zoster Gangrenosus," "Sarcoma of the Kidney in Children," "Cardiac Sedatives," "Prostatic Tuberculosis," "Medical Septicæmia," and "Effects of La Grippe on the Nose, Throat, and Ear." A notable innovation, one we heartily commend, is the absence of "editorials," since it is to be presumed the editor will give expression to his opinions in direct personal contributions.

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### MEDICAL HISTORY. AND



# MEDICINE

A Monthly Journal of Medicine and Surgery.

HAROLD N. MOYER, M. D.,  
EDITOR.

VOL. 1.  
No. 2.

JUNE, 1895.

\$2.00  
PER YEAR.

## CONTENTS.

### ORIGINAL ARTICLES.

- SOME CONSIDERATIONS CONCERNING THE LOCATION AND DETECTION OF MISSILES. By ROBERT PARK, A.M., M.D. 149  
THE SURGICAL AND MEDICAL TREATMENT OF CHOLELITHIASIS. By JOHN B. WENGER, A.M., M.D. 155  
RELATION OF INDUCTION TO THE NERVOUS SYSTEM. By HAROLD N. MOYER, M.D. 161  
THE TREATMENT OF EPILEPSY. By T. E. STANTON, M.D. 167

### BOOK REVIEWS.

- A System of Legal Medicine. By ALICE MCLEOD HAMILTON, M.D., and LAWRENCE HODGINS, Esq. 175  
Atlas des Hémorrhagies (GÉNÉRALES) DES FEMMES. Van De KIEFF PARS. 176  
NOTES ON NEW BOOKS. 177

### PROGRESS OF MEDICAL SCIENCE.

#### MEDICINE.

- Early Diagnosis of Carcinoma of the Stomach. 184

#### SURGERY.

- New Method of Inducing General Anesthesia. 185  
Indications for Operation in Vaginal Cancer. 185  
The Operative Treatment of Diabetes. 185  
A New Obviator. 185  
Mechanism of Death in Cocaine Intoxication. 185  
Sarcoma Coexisting with a Recent Fracture. 185  
Epilepsy. 185  
"Bottom" of Absorbable Pad. 185

#### PATHOLOGY.

- Acute Yellow Atrophy of the Liver, with Special Reference to the Regenerative Changes Observed. 190

#### THERAPEUTICS.

- Classification of the Spots of Tuberculous Patients by Means of Wood-Springs. 195  
Thyroid Gland as Treatment of Goiter. 197  
Hepatic Symptoms Resulting from the Use of Food. 197  
The Changes of Thyroid Feeding. 197  
Soluble Salicylate in Phosphobismuth Goiter. 197  
Response to the Treatment of Goiter by Iodine. 197

- Comparative Anesthetic Action of Potassium Iodide Fatty Acid. 190  
Action of Salt on Stomach Digestion, and of Alkali on Salivary Digestion. 190  
The Use of Mercury in Anesthesiology. 190

#### OBSTETRICS AND GYNECOLOGY.

- The Puerperal Infection in Abdominal Surgery. 195  
Freund's New Operation for Vaginal Prolapse. 195  
A Case of Chronic Infection of the Uterus Successfully Treated with Electric Treatments. 195  
Wandering Dermoid Tumor. 195  
The Huesthede's Treatment of Hysterical Menstruation. 195  
An Anomaly in Placenta. 195

#### NEUROLOGY AND PSYCHIATRY.

- The Differential Diagnosis of Brain Tumors. 195  
Anxiety Neurosis. 195

#### OPHTHALMOLOGY.

- Parachromatin Keratitis and Tubercular Disease of the Eye. 195

#### FORENSIC MEDICINE.

- Responsibility of Physicians. 195

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DETROIT, MICH.

Entered at the Post-office at Detroit, Mich., as second-class matter.